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1. Chemical characteristics of nerve agents

(1) Tabun, Sarin, Soman and VX are known as typical nerve agents used for chemical weapons. All these agents are organophosphorus compounds. While Tabun which was developed in earlier stage, can be produced from yellow phosporus and through phosphorus oxychloride, Sarin, Soman and VX can be produced from yellow phosphorus and through such common intermediates as phosphorus trichloride, dimethylphosphite or methylphosphonic dichloride (or difluoride). It is pointed out in this connexion that these three agents contain methylphosphorus bond (alkyl-phosphorus bond) causing particularly strong poisonous effects on warm-blooded animals.

(2) Among the agricultural chemicals of organophosphorus family, which are widely used as insecticides or bactericides, there are some (for example, Parathion or TEPP) which can be used, due to their highly poisonous effects and depending upon their dosage, as nerve agents for weapon purposes. These agricultural chemicals of organophosphorus family can be produced from phosphorus trichloride, phosphorus oxychloride, phosphorus pentasulfide and phosphorus pentachloride.

(3) All of these organophosphorus compounds are produced from yellow phosphorus as their starting material which is then converted to phosphorus trichloride, phosphorus oxychloride, phosphorus pentasulfide or phosphorus pentachloride by chemical reactions. It is further noted that dimethylphosphite and/or methylphosphonic dichloride (or difluoride) which are the intermediates derived mainly from phosphorus trichloride, lead to the production of Sarin, Soman and VX.

2. Peaceful uses of raw materials and intermediates

(1) Yellow phosphorus is mass-produced as the material for various inorganic and organic phosphorus compounds.

(2) Phosphorus trichloride, phosphorus oxychloride, phosphorus pentasulfide and phosphorus pentachloride are produced from yellow phosphorus and are the common raw materials used widely for the production of agricultural chemicals, pharmaceuticals and dyestuffs, etc.

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(3) Dimethylphosphite is mainly produced from phosphorus trichloride and is widely used for peaceful industry as synthesizing materials for insecticides, bactericides, flame retardants, and as additives to lubricants.

(4) Methylphosphonic dichloride (or difluoride) is mainly produced from dimethylphosphite. Detailed information regarding its use for peaceful purposes is limited. However, as this agent is reported to be used as material for the preparation of phosphorus polymer, it is likely that other peaceful uses of that agent might be found in future.

3. Possible check points

As shown above, the production of nerve agents and agricultural chemicals of organophosphorus family having poisonous effects equivalent to nerve agents, requires particular kind of materials which are widely used for the production of other industrial goods.

Therefore, it should become possible to see whether or not these materials are being used for the production of chemical weapons if we can trace the flow of such materials in each State by checking the amount of their production, import and export, or the amount of their consumption for different purposes, these materials are enumerated as follows: yellow phosphorus, phosphorus trichloride, phosphorus oxychloride, phosphorus pentasulfide, phosphorus pentachloride, dimethylphosphite and methylphosphonic dichloride (or difluoride).

In so doing, it should be possible to prevent these particular materials from being diverted into the production of nerve agents or to deter improper use of highly poisonous organophosphorus agricultural chemicals as chemical warfare agents.

N.B. It is understood that our study should be pursued on new intermediates which may be discovered in future, as organophosphorus chemical industry develops.